2019 Shaft Fitting Addendum

Featuring the DYNAMIC SHAFT FITTING INDEX

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Published by
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Acknowledgments

We would like to thank Graeme Horwood and the former Apollo Shaft Corp. technical staff for their assistance in compiling much of original data in this project (1989-1992). Our thanks also are offered to the technical staffs of many of the companies whose products are featured in this addendum for their assistance and recommendations.

I would personally like to thank all the owners of Hireko and the former Dynacraft for allowing myself the time and resources to conduct all of the testing. I would especially thank all the fellow tech staff members, past and present, for completing the day-to-day requirements, allowing myself to test the shafts throughout the course of the year. A special thank you goes out to Forest Sands who had been instrumental in designing most of the shaft testing equipment that we use for testing.

Most importantly, thanks to the thousands of clubmakers around the world who have taken this information and put it to practical use. Your kind comments and valuable input about this continuing project, and your shaft fitting success stories, are a great source of inspiration!

2019 Shaft Fitting Addendum

Our Independent Research on Shafts Enters Its 30th Year

Table of Contents

The “2019 Shaft Fitting Addendum” to “The Modern Guide to Shaft Fitting” contains thousands of shaft specifications that you will find of invaluable use in your custom clubfitting and shaft selection work. Detailed independent testing has generated all the charts that follow.

All specifications listed within this volume have been obtained from the unprecedented and ongoing Shaft Testing Project. This began in 1989 with an initial group of 800 golf shafts. Now supplemented by subsequent testing of more than three thousand additional shaft models, this project was started from the idea that golf shafts should be tested through uniform standards to obtain true “apples-to-apples” comparison between the various shaft designs. As detailed in the main text of “The Modern Guide to Shaft Fitting”, shaft manufacturers use widely varying methods to determine the parameters of their products, so making shaft-to-shaft comparisons through only specifications from different suppliers cannot be viewed as reliable. Only in this addendum you will find the specifications of nearly 4000 shafts that have been available to the component market, all tested under the same precise conditions.

It is very likely that some specifications listed in these pages will vary from those offered by shaft manufacturers and other golf club component distributors. Yet this should not be viewed, as indicating one measurement or another is incorrect. Rather, these variations are due to different testing methods used to obtain a particular specification. This book contains shaft specifications that were obtained under the test conditions detailed in Chapter 2 of “The Modern Guide to Shaft Fitting”.

“The 2019 Shaft Fitting Addendum” has undergone many changes over the years. The most notable change was the formula for rating shafts which was refined in 2007. Since its inception, the Shaft Fitting Addendum has offered the Dynamic Shaft Fitting Index (DSFI) as a means of comparing the stiffness of one shaft to another, and that index number could apply to the person’s swing speed. The calculation to obtain this index number was derived from the cut shaft frequency and torque (see Chapter 7 of “The Modern Guide to Shaft Fitting”). While this formula has worked well in the first 18 years, we are always trying to improve upon understanding what makes a shaft stiff (or flexible) and how to relate that to why golfers successfully used what they do.

Starting in the “2006 Shaft Fitting Addendum”, we added the deflection measurements to the original DSFI methods to become the new standard method of determining the DSFI rating of a shaft. For the past ten years we have been using a digital deflection board to measure stiffness, to augment the frequency readings. The traditional method of deflection is to measure it with the butt clamped into the fixture (Butt deflection). However, we had also added another parameter and that is the tip deflection to determine relative stiffness to the other end of the shaft, which has become a hot topic. Next, we created a ratio between the butt and tip deflection to predict ahead of time what shafts may hit the ball higher or lower or might be draw or fade enhancing. The sad part is after 10 years our “homemade” digital deflection board is no longer providing accurate measurements and will no longer be utilized. We have added a new instrument in its place that we are very excited about. This will measure deflections along a much larger span of the shaft and provide a more accurate picture in the shaft fitting puzzle, but that won’t be part of the “2019 Shaft Fitting Addendum”. However, the biggest change has been converting iron and hybrid swing speed ratings to driver swing speeds to account for variations in iron swing speeds with different devices as well as provide something that more golfers have access to – driver speed.

The "2019 Shaft Fitting Addendum" is divided into multiple sections. After 30 years of testing, far more than half of the shafts have either been deleted from manufacturers' current product line or in some unfortunate cases, the shaft company is no longer in business. Because of the influx of new shafts, we felt it best to keep all the information in one text as a way to compare the old and new shafts alike. This way, clubmakers can utilize the "2019 Shaft Fitting Addendum" to make educated choices for replacement or substituted shafts.

Starting ten years ago, the tip trimming amounts were added to each of the shafts in the Current chapter. For frequency savvy clubmakers they might be able to interpolate what frequencies could be obtainable by tip trimming less than what was listed, or in some cases more (if amply parallel tip section and overall shaft length are not issues). In addition, the number of Archived Shafts had become so large, they we divided these sections in two to make it easier to download the respective chapters.

We have a procedural outline in Chapter 5 to follow when selecting shafts based on the swing speed and tempo of the golfer. There are also examples in which to follow that might make it easier to understand the Principles of DSFI. This addendum also provides an outline to allow you to pre-determine head weight, swingweight and even frequency prior to assembling the club when you are making a change from our standard testing procedures. Field observations as well as the questions club fitters have had using the DSFI in the past brought about all these additions we made since the Shaft Fitting Addendum was introduced. All in all, these additions should be even more user friendly in you shaft fitting selections.

Next, allow us to provide an explanation of why we believe the Dynamic Shaft Fitting Index remains the No.1 method for modern shaft selection. Since the innovative index was first published in 1992, some shaft manufacturers, major OEM's and various component distributors have followed suit in recommending shaft models by swing speed ratings. These can serve as a valuable source of information to the clubmakers, yet these are not likely to represent the comprehensive picture that "The Modern Guide to Shaft Fitting" and DSFI provide. DSFI not only offers recommended swing speeds for the majority of shafts used by clubmakers today, it does so based on *actual cut shaft measurements* based on the manufacturers recommended trimming instructions. In other words, DSFI recommendations are based upon shaft performance characteristics, as clubmakers and their customers will experience them. Other listings are based purely upon raw shaft specifications, or upon specifications provided by the manufacturer, and thus cannot be regarded as truly independent. Every shaft listed in this publication has been individually tested and quantified by the Hireko (formerly Dynacraft) Technical Staff.

There is one final word about the testing. For many clubmakers who have used this reference book on a yearly basis to help guide you through your daily fitting you will probably feel like there a lot less new shaft entries after thumbing through Chapter 2 Current Shaft Data. This has occurred as a result of the ever increasing cost of shafts. The annual Shaft Fitting Addendum has been available for free for several years now. To obtain accurate results the shafts need to be cut and cannot be sold as new. So we have relied on the benevolence of the shaft manufacturers to supply what they can in order to provide the information contained throughout.

Finally, for a more complete tutorial on implementing the Dynamic Shaft Fitting Index in your clubmaking, please refer to Chapter 7 of "The Modern Guide to Shaft Fitting". An updated, quick reference guide also is contained in Chapter 5 of this book. For those who do not currently have the "Modern Guide to Shaft Fitting", you can download it for free.

Additionally, at the beginning of each section you will find a brief introduction about the set of specifications and a table of contents for that section. Use these guides to find the shaft model or reference the specification that is required.

CUT SHAFT DATA

In hand with the DSFI Swing Speed Ratings, this section contains the most important, and most usable, information in this publication. All cut shaft specifications have been obtained according to the assembled club parameters detailed in Chapter 2 of "The Modern Guide to Shaft Fitting".

Cut Shaft Data

In the "Shaft Fitting Addendum", you will find that many of the shafts were tested at different lengths. In the 30 years of testing, many changes in the golf industry have taken place. In 1989, standard lengths for drivers were 43" and #5-irons 37.5" for men's, while L-flex shafts were built to 1" less. Both graphite and steel shafted clubs were tested at the same length as weight ports were normal in woods and graphite-weight irons (10g heavier than standard weight heads) were available on the market. This also allowed one to truly compare steel and graphite shafts as they were tested using the same testing conditions.

We have always felt it was important for clubmakers to have useful information based upon the design applications of the shafts in question and to real life situations. As major OEM began to make their graphite-shafted clubs longer, the component market shortly followed suit, partially to the lack of graphite-weighted irons and the elimination of weight ports. In order to achieve normal swingweight, the length was increased proportionally by 1". In 1996, a new breed of ultra-lightweight graphite shafts emerged. The standard lengths of drivers made with these particular shafts was increased to 45" (44" for ladies flex), thus our testing was increased accordingly to reflect this change. In the past few years, we have also increased the length of all drivers with graphite shafts weighing less than 90g to 45" (44" for ladies flex). Our staff has also changed the length of men's flex steel-shafted irons to 38" (37" for ladies flex) on all new models to reflect what has become commonplace in the industry today. Regardless, it is important to know the DSFI takes in account the testing lengths therefore it did not make sense to retest every single shaft in this addendum (nor practical understanding the scope and time requirements of this project).

Some Cut Shaft entries may have gaps in their listings, particularly in the Archived shaft sections, in regards to raw shaft weight, raw shaft balance point, and tip and butt diameters. Many of these listings were tested in the spring of 1992. In order to publish the results, our technical staff opted to go ahead and trim them according to the manufacturer specifications and include that data in the '92 Cut Shaft Data. Once the shaft was trimmed, however, the initial tip diameter, butt diameter, raw shaft weight and balance points were lost, as the shaft was no longer in its original form. But as golfers play with shafts in their cut form, this should not be a cause of concern to the clubmakers. In 2004, the arduous task of retesting all the older shafts began to obtain butt and tip deflection measurements as this became an important part of the testing. Unfortunately, not all the shafts could be located due to either breakage, placed into demo clubs, shafts sent back to the manufacturer or even a clubmaker who loaned the shaft(s) for testing.

Again, as golfers play golf with shafts that have been cut to proper playing length, these Cut Shaft Data charts can serve as a valuable source of information in your clubmaking work. Unlike fitting guides that are based on uncut shaft specifications, measurements derived from shafts in their proper playing form are eminently more appropriate for fitting comparisons. These are the specifications upon which the DSFI listings that follow this section are based.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

FLEX is simply the starting point provided by the manufacturers to describe the stiffness of their shafts. When possible, the L, A, R, S and X-flexes of each shaft for woods and irons were tested. **Raw Weight** is simply the static weight of the shaft before it was trimmed for testing. **Tip Diameter and Butt Diameter** is measured with calipers to within 0.01".

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

For cut shaft testing, three different variations of **balance point** were recorded. Balance Point #1 (BP1) was based on the raw shaft before trimming. Balance Point #2 (BP2) was the measurement of balance point after trimming for installation into a clubhead. Balance Point #3 (BP3) was the balance point measurement for the club when assembled with the test clubhead and grips at standard length and swingweight C-6 (ladies length) or D-1 (at men's length). In all cases, the balance points are measured up from the tip of the shaft (or ground line on BP3).

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

Static weight is the overall measurement of the club's total weight when assembled with a matching core size grip and the appropriate Driver, hybrid or #5-iron. Similarly, **head weight, grip weight and cut shaft weight** were recorded to allow comparisons of the total weight of the test Drivers, hybrids and #5-irons that were assembled to the C-6 and/or D-1 swingweights. While critical to the overall placement of the shaft in the DSFI rankings, these parameters are not addressed individually in the text of the book.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

Shaft frequency refers to the number of cycles per minute (cpm) that the shaft registered after assembly to the appropriate finished Driver, Hybrid or #5-iron specifications. The standard swingweights for the L-flex clubs is C-6 and Men's flexes are tested at D-1. The frequency measurements are recorded for the both men's and ladies metal wood Drivers, fairway utility, hybrids and #5-irons at the length listed six columns to the right. Frequency derived from butt clamping 5.25" with the gripped club.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

Butt and tip deflection readings are two measurements to compare relative flex using a deflection board with a load cell to record the force when the shaft is deflected 4". The measurement is provided in ounces of force and the cantilevered length is 5.25", which is the same as the frequency to show how these two measurements compare. Deflection is a long time measurement for flex, because it is analogous to the shape of the shaft when it is bent during the swing. Normally deflection has been recorded by clamping the butt end. We have also included tip deflection to provide added insight into tip stiffness.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

T/B Ratio stands for tip-to-butt ratio. This is simply the relationship between the tip and butt deflection measurements (technically the butt-to-tip) to illustrate the stiffness distribution of the shaft. Shafts that have higher T/B ratios can be described as lower bend points (tip weak, butt stiff) or shafts that might produce a higher trajectory. Shafts with a lower T/B ratio can be described as possessing a higher bend point (firm tip, weak butt) or lower launch angle shafts. The T/B ratio does not reflect the actual bend point location, rather provides a meaningful parameter to predict which shafts may launch the ball either higher or lower relative to one another.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

Cut shaft torque from 1989-92 was recorded on Apollo's test machinery as a tip-attached load cell moved in a clockwise, then counter-clockwise direction to measure that shaft's resistance to twisting. Torque testing was recorded at 1 ft.-lb. force (as in the raw shaft testing) and was performed in both directions, with the torque listed as the average of the two readings. From 1992 to the present, torque testing was conducted under the same conditions in our research facilities. **Raw shaft torque** has been tested at our testing facilities for new shafts to reveal the torque difference that result from trimming. In each case, torque measured by clamping 2" of the butt and affixing the torque arm 1" from the tip of the cut or uncut shaft.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

Length is simply the actual assembled club length that was tested at to provide the data. **Bore Type** (woods only). Due to the many hosel lengths and tip insertion depths and subsequent bottom of bore to ground line measurement (BBGM) that exist in metal wood heads today, it was necessary to create this parameter. For the purposes of identifying the bores, the original metal wood used for testing was a small size metal wood with a 3" hosel and 1.5" insertion depth and a 1.5" BBGM. This head is classified as a M1 bore type. The Mid-Size metal wood used for testing has a 2.5" hosel, 1.5" insertion depth and 1" BBGM and classified as a M2 bore type. Lastly, an oversized stainless steel metal wood used for this testing has a 1.75" hosel; 1.25" insertion depth and 0.5" BBGM that will be classified as a BB bore type. Fairway utility woods, hybrids and iron shafts will not have a bore type classification. For the record, the #5-iron used for testing has 2.33" hosel length, 1.33" insertion depth and 1" BBGM.

Flex	Raw Weight (g)	Tip Dia. (in.)	Butt Dia. (in.)	BP1 (in.)	BP2 (in.)	BP3 (in.)	Static Weight (g)	Head Weight (g)	Grip Weight (g)	Shaft Weight (g)	Freq. (cpm)	Butt Deflect. (oz.)	Tip Deflect. (.oz.)	T/B Ratio	Torque Cut (deg)	Torque Raw (deg)	Length -Bore Type	DSFI

The final listings, the **DSFI swing speed ratings**, are the most relevant information contained in this section. DSFI is short for the Dynamic Shaft Fitting Index or an algorithm that uses the frequency, torque, length, tip and butt deflection measurement to put a number on the overall stiffness of the shaft. While all the parameters listing in these charts are important to your reference, it is the DSFI calculation that immediately reveals if a particular shaft should be considered for a certain player. We recommend starting any shaft fitting session by recording the golfer's average swing speed and then referring to the DSFI listings in Chapter 5 of this addendum. After narrowing down the list of shaft choices to those in the player's recommended swing speed ranges, refer to these charts for additional information on specific models.